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(54) Title: WEB/EMULATOR SERVER AND WEB BROWSER TERMINAL EMULATOR FOR PERSISTENT CONNECTION TO A LEGACY HOST SYSTEM OPERATION			
<p>The diagram illustrates a computer network environment (10) with the following components and connections:</p> <ul style="list-style-type: none"><li><b>Legacy Host System (18, 19):</b> Contains a Legacy Host System (18) and a Legacy Host System (19). They are connected to a Gateway System (22) via lines 20 and 21.</li><li><b>Server System (24):</b> Contains a Web/Emulator Server (26) and a Client Thread (28). It is connected to the Legacy Host System (18, 19) via lines 30 and 31, and to the Client System (36) via line 32.</li><li><b>Client System (36):</b> Contains a Web Browser (38) and a Virtual Machine (40). It is connected to the Server System (24) via line 33 and to an Applet Process (42) via line 34.</li><li><b>Public Network/Internet (44):</b> Contains a Client System (36) executing an Applet Process (42) under a Web Browser (38). It is connected to the Server System (24) via line 44.</li></ul> <p>Annotations in the diagram include: - "PERSISTENT TCP/IP SOCKET CONNECTION" between Legacy Host System (18, 19) and Server System (24). - "PERSISTENT TCP/IP SOCKET CONNECTION" between Server System (24) and Client System (36). - "PERSISTENT TCP/IP SOCKET CONNECTION" between Client System (36) and Public Network/Internet (44). - Line numbers: 10, 18, 20, 21, 22, 24, 26, 28, 30, 31, 32, 33, 34, 36, 38, 40, 42, 44.</p>			
(57) Abstract			
<p>A computer network environment (10) allowing connection of a client system (36) to a legacy host system (18, 19) using a web/emulator server (26) is provided. The computer network environment (10) includes a legacy host system (18, 19) having TCP/IP connectivity. The legacy host system (18, 19) is operable to support a terminal session for access to the legacy host system (18, 19). The computer network environment (10) also includes a server system (24) executing a client thread (28) under a web/emulator server (26). The client thread (28) is operable to communicate with the legacy host system (18, 19) across a persistent TCP/IP socket connection (30). The computer network environment (10) further includes a client system (36) executing an applet process (42) under a web browser (38). The applet process (42) is operable to communicate with the client thread (28) across another persistent TCP/IP socket connection (44) and is operable to provide a terminal session to a user of the client system (36). This terminal session is supported by a persistent connection allowing real-time bidirectional communication with the legacy host system (18, 19).</p>			

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**WEB/EMULATOR SERVER AND WEB BROWSER TERMINAL EMULATOR FOR PERSISTENT CONNECTION TO A LEGACY HOST SYSTEM OPERATION**

**TECHNICAL FIELD OF THE INVENTION**

This invention relates in general to the field of electronic systems, and more particularly to a web/emulator server and a web browser terminal emulator for persistent connection to a legacy host system and a method of operation.

**BACKGROUND OF THE INVENTION**

Many organizations operate computer network environments that include legacy host systems which store data and provide applications important to the operation of the organization. Such legacy host systems can include IBM mainframes (MVS, VM and VSE environments), IBM AS/400 systems and UNIX host systems.

It is desirable for such organizations to provide connection to the legacy host systems through terminal sessions on distributed client systems such as personal computers and computer workstations. This connection to the legacy host system provides access for users of the client systems to the data and applications on the legacy host system. These terminal sessions can include 3270, 5250, NVT and VT220 type terminal sessions.

One conventional method for providing terminal sessions is to execute a terminal emulator application on the client systems that connects directly to a host legacy system using a TCP/IP socket connection. Another

conventional method is to provide connection through a web browser application by translating standard legacy data flows into HTML pages. However, such conventional web browser methods suffer from an inability to handle 5 real-time host updates to user screens as well as other significant problems. For example, forms-based HTML/TN3270 packages are unable to overcome a range of problems associated with common HTML implementations such as real-time host updates to user screens or finding a 10 user's browser platform address on the network.

#### SUMMARY OF THE INVENTION

In accordance with the present invention, a 15 web/emulator server and a web browser terminal emulator for persistent connection to a legacy host system and a method of operation are provided that substantially eliminate or reduce disadvantages and problems associated with previously developed methods.

According to one aspect of the present invention, a 20 computer network environment allowing connection of a client system to a legacy host system using a web/emulator server is provided. The computer network environment includes a legacy host system having TCP/IP connectivity. The legacy host system is operable to 25 support a terminal session for access to the legacy host system. The computer network environment also includes a server system executing a client thread under a web/emulator server. The client thread is operable to communicate with the legacy host system across a 30 persistent TCP/IP socket connection. The computer network environment further includes a client system executing an applet process under a web browser. The applet process is operable to communicate with the client thread across another persistent TCP/IP socket connection 35 and is operable to provide a terminal session to a user.

of the client system. This terminal session is supported by a persistent connection allowing real-time bidirectional communication with the legacy host system.

According to another aspect of the present invention, a web/emulator server for providing a persistent connection between a client system and a legacy host system is provided. The web/emulator server includes a client thread operable to communicate with a legacy host system across a persistent TCP/IP socket connection. The web/emulator server also includes applet code operable to create an applet process executing under a web browser on a client system. When executed, the applet process is operable to communicate with the client thread across another persistent TCP/IP socket connection and to provide a terminal session to a user of the client system. The web/server emulator is operable to download the applet code to a client system in response to receiving a uniform resource locator associated with the legacy host system.

According to a further aspect of the present invention, a method is provided for connecting a client system to a legacy host system using a web/emulator server. A uniform resource locator associated with a legacy host system is selected from a web browser executing on a client system. The uniform resource locator is received by a web/emulator server executing on a server system. Executable code for an applet process is then downloaded to the client system, and the applet process is executed under the web browser on the client system. The applet process is connected to a client thread executing under the web/emulator server via a persistent TCP/IP socket connection. The client thread is connected to a legacy host system associated with the uniform resource locator via another persistent TCP/IP socket connection. The client thread and the legacy host

system communicate across the first persistent TCP/IP socket connection, and the client thread and the applet process communicate across the second persistent TCP/IP socket connection. A terminal session is provided by the applet process to a user of the client system which allows real-time bidirectional communication with the legacy host system across a persistent connection to the legacy host system.

A technical advantage of the present invention is the ability to allow users to access legacy host system data, such as IBM mainframe data, from client systems, such as desk top personal computers and computer workstations, using a web browser where the access is provided through a persistent TCP/IP socket connection to the legacy host system. This ensures a persistent bidirectional connection to the legacy host system such that real-time host updates, security, encryption, help-desk support, and other real-time features can be supported. One embodiment of the present invention uses SUN MICROSYSTEMS' JAVA technology and includes JAVA-capable web browsers and embedded JAVA applet processes to provide terminal session connectivity to the distributed client systems.

Another technical advantage of the present invention is the provision of connectivity to a legacy host system through web browsers without the need for specialized emulation software to be manually loaded on each client computer system and without the need for user programming.

A further technical advantage of the present invention is allowing the expansion of access to existing data and applications on legacy host systems from existing client systems using existing network capabilities. The present invention provides a network environment that allows the use of a web browser

environment, having web browser tools, such as JAVA tools, and web-serving, to incorporate Internet-type technologies, through the Internet or an intranet, with existing network architectures.

5

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a block diagram of a computer network environment that allows connection of a client system to a legacy host system using a web/emulator server according to the teachings of the present invention;

FIGURE 2 is a flow chart of a method for connecting a client system to a legacy host system using a web/emulator server according to the teachings of the present invention; and

FIGURE 3 is a block diagram of load-balancing across multiple web/emulator servers according to the teachings of the present invention.

#### DETAILED DESCRIPTION OF THE INVENTION

FIGURE 1 is a block diagram of a computer network environment, indicated generally at 10. Network environment 10 includes a legacy/SNA environment 12, a TCP/IP environment 14 and a public Internet/intranet environment 16.

Legacy/SNA environment 12 includes one or more legacy host systems such as an IBM host system 18 and a UNIX host system 19. IBM host system 18 can comprise an IBM mainframe, (MVS, VM and VSE environment) or an IBM AS/400 system. UNIX host system 19 can comprise a computer workstation or server running a UNIX-type environment.

A gateway system 20 can be coupled to IBM host system 18 via a connection 22. Connection 22 can comprise an SNA or channel attachment to IBM host system 18. Gateway system 20 provides an interface between

legacy/SNA environment 12 and TCP/IP environment 14. Gateway system 20 can be integral with IBM host system 18 or can be a separate, add-on system extending the functionality of IBM host system 18. For example, 5 gateway system 20 can comprise an OC SERVER II™ gateway product available from OPENCONNECT SYSTEMS. UNIX host systems 19 and some IBM host systems 18 have built in TCP/IP connectivity such that the use of a gateway system 20 is unnecessary.

10 TCP/IP environment 14 includes a server system 24. Server system 24 executes one or more web/emulator servers 26. Web/emulation server 26 provides an interface between TCP/IP environment 14 and public Internet/intranet environment 16 and is operable to 15 execute one or more client threads 28. Web/emulator server 26 is operable to connect to gateway system 20, to IBM host system 18 and to UNIX host system 19 via a persistent TCP/IP socket connection 30. Server system 24 includes a data storage device 32 that stores applet code 20 34. Applet code 34 comprises executable code for an applet process. Web/emulation server 26 can comprise an OC://WEBCONNECT™ server available from OPENCONNECT SYSTEMS, and applet code 34 can comprise a JAVA applet for use within SUN MICROSYSTEM's JAVA environment.

25 Public Internet/intranet environment 16 includes one or more client systems 36. Client system 36 can comprise a desk top computer such as a personal computer or computer workstation. Client system 36 is operable to execute a web browser 38. Web browser 38 is operable to 30 establish a virtual machine 40 for executing an applet process 42. Applet process 42 comprises an instance of applet code 34 downloaded to client system 36 by web/emulator server 26. Applet process 42 is connected to client thread 28 via a persistent TCP/IP socket 35 connection 44. Web browser 38 can comprise a

commercially available web browser application such as NETSCAPE NAVIGATOR that is JAVA-capable and applet process 42 can comprise a JAVA applet.

In operation, web/emulator server 26, client thread 28 and applet process 42 form a web browser terminal emulator providing a persistent bidirectional connection between client system 36 and a legacy host system such as IBM host system 18 or UNIX host system 19. Applet process 42 communicates with client thread 28 across persistent TCP/IP socket connection 44. Client thread 28 communicates with an appropriate legacy host system, either IBM host system 18 or UNIX host system 19, across a persistent TCP/IP socket connection 30. Client thread 28 and applet process 42 allow a user of client system 36 to use web browser 38 to invoke a terminal session for accessing data and applications on a legacy host system. Each web/emulation server 26 is operable to manage a plurality of client threads 28 associated with a plurality of applet processes 42. In one embodiment of the present invention, each web/emulation server 26 is operable to manage a thousand such connections.

Client thread 28 executes under web/emulator server 26 and is operable to communicate with a legacy host system across a persistent TCP/IP socket connection 30. Client thread 28 is operable to interface between TCP/IP environment 14 and public Internet/intranet environment 16. Applet process 42 executes under web browser 38 and is operable to communicate with client thread 28 across persistent TCP/IP socket connection 44. In one embodiment of the present invention, client thread 28 and applet process 42 using a web/emulator data flow. Applet process 42 is further operable to provide a terminal session to a user of the client system 36. The terminal session can comprise a 3270, 5250, NVT or VT220 type terminal session. This terminal session provided by

applet process 42 and client thread 28 is supported by a persistent TCP/IP socket connection which allows real-time bidirectional communication with the legacy host system.

5 In one embodiment of the present invention, the applet process uses three threads to implement the terminal session. The applet process uses a READ thread, a WRITE thread and an EMULATION thread. The READ thread provides a buffer interface to persistent TCP/IP socket connection 44 and reads information from the socket. The WRITE thread provides a buffer interface to persistent TCP/IP socket connection 44 and writes to the socket. The EMULATION thread provides the user interface representing the terminal session on the legacy host system. In this embodiment, the applet process and the client thread communicate using a web/emulator data flow based upon the communication protocol that is set forth in APPENDIX A.

10 20 According to the present invention, a user of client system 36 can access data and applications on the legacy host system using web browser 38 where the access is provided through a persistent bidirectional connection to the legacy host system. Persistent TCP/IP socket connections 30 and 44 provide this persistent bidirectional connection to IBM host system 18 or UNIX host system 19 such that real-time host updates, security, encryption, help-desk support, and other real-time features are supported. One embodiment of the present invention uses SUN MICROSYSTEMS' JAVA technology and includes JAVA-capable web browsers 38 and embedded JAVA applet processes 42 to provide terminal session connectivity to client systems 36.

15 25 30 35 The present invention provides connectivity to legacy host systems such as IBM host system 18 and UNIX host system 19 through web browser 38 without the need

for specialized emulation software to be manually loaded on each client system 36 and without the need for user programming. Web/emulator server 26 downloads applet code 34 to client system 36 when the uniform resource locator (URL) of the legacy host system is selected by the user. This is accomplished automatically without requiring service personnel to load software on client system 36.

The present invention also allows the expansion of access to existing data and applications on legacy host systems from existing client systems 36 using existing network capabilities. The present invention provides a network environment 10 that allows the use of a public Internet/intranet environment 16 having web browser tools, such as JAVA tools, and web-serving to incorporate Internet-type technologies, through the Internet or an intranet, with existing network architectures. Thus, an organization can implement web browser 38 based access to legacy host systems, such as IBM host systems 18 and UNIX host systems 19, without scrapping or significantly restructuring existing network resources.

FIGURE 2 is a flow chart of a method for connecting a client system to a legacy host system using a web/emulator server according to the teachings of the present invention.

In step 50, a uniform resource locator (URL) associated with a legacy host system is selected from a web browser executing on a client system. The web browser can comprise a JAVA-capable NETSCAPE NAVIGATOR web browser as mentioned above. The selected uniform resource locator is received by a web/emulator server in step 52. In step 54, the web/emulator server downloads executable code for an applet process to the client system for connecting to the legacy host system. In step 56, the client system executes the applet process under

the web browser. The applet process can comprise a JAVA applet for execution within a JAVA virtual machine within the NETSCAPE NAVIGATOR web browser.

5 In step 57, the applet process connects to a client thread executed by the web/emulator server, and the client thread connects to the legacy host system across persistent TCP/IP socket connections. In step 58, the client thread then communicates with the legacy host system across the persistent TCP/IP socket connection.

10 This communication allows the client thread to establish and maintain a terminal connection to the legacy host system. In step 60, the client thread communicates with the applet process across a persistent TCP/IP socket connection. This communication can be accomplished using

15 a web/emulator data flow such as that based upon the communication protocol set forth in APPENDIX A.

20 In step 62, the applet process provides a terminal session to a user of the client system. According to the present invention, this terminal session allows real-time bidirectional communication with the legacy host system across a persistent TCP/IP socket connection to the legacy host system. This terminal session, as mentioned above, can comprise a 3270, 5250, NVT or VT220 type terminal session.

25 The terminal session can be terminated by the user of the client system as desired. The applet process and client thread are terminated, in step 64, when the terminal session is terminated. In one embodiment, after termination, the applet process is removed from execution memory and is no longer present on the client system. In another embodiment, the executable code for the applet can be stored on a data storage device associated with the client system. In this embodiment, the web/emulation server can check the client system to determine whether new executable code for the applet needs to be downloaded

based upon the version present, if any, on the data storage device of the client system.

The present invention provides an interface to legacy data flows, such as telnet (TN) data flows, across 5 persistent TCP/IP socket connections to give users persistent bidirectional access to legacy host system data in terminal sessions, such as 3270, 5250, NVT and VT220 type terminal sessions. According to the present invention, terminal emulation is partially provided by 10 applet executable code downloaded from the web/emulation server. The user can select the uniform resource locator (URL) of the legacy host system via a web browser package, such as NETSCAPE's NETSCAPE NAVIGATOR, and 15 transparently receive the applet code which is executed and invokes an appropriate terminal session.

The present invention provides users of the client system access to real-time legacy host system data and applications using a web browser. The web/emulator server system converts standard legacy data flows into 20 web/emulator data flows and vice versa permitting multi-session, multi-protocol access to legacy data and applications. The applet process converts the web/emulator data flows into a terminal session for display to the user. As mentioned above, the web browser 25 can comprise a JAVA-capable web browser, the applet process can be a JAVA applet, and the web/emulator data flow can be based upon the protocol set forth in Appendix A. This embodiment of the present invention can blend web browsers enhanced by SUN MICROSYSTEMS' JAVA with 30 legacy host systems having TCP/IP connectivity to allow users on any client system platform to connect to and access legacy host systems via 3270, 5250, NVT and VT220 type terminal emulation.

35 FIGURE 3 is a block diagram of load-balancing across multiple web/emulator servers according to the teachings

of the present invention. An HTTP server 70 is coupled to a client system 72. HTTP server 70 receives request information, REQUEST, from client system 72 in the form of a uniform resource locator (URL) and provides 5 redirection information, REDIRECT, to client system 72. Client system 72 is then coupled to one of a plurality of web/emulation servers 74 according to the redirection 10 information. In this manner HTTP server 70 can redirect access by a plurality of client systems 72 to manage the load on web/emulation servers 74 to ensure a balance across all available web/emulation servers 74.

This load-balancing can remain transparent to a user of client system 72. The user enters the uniform 15 resource locator associated with the legacy host system. That information is transmitted to HTTP server 70 as a request. HTTP server 70 interprets the request, identifies the selected legacy host system, and selects a web/emulation server 74 to manage the connection. This 20 selection of a web/emulation server 74 can be based upon information of the current loading of each web/emulation server 74. HTTP server 70 transparently provides redirect information to client system 72 which identifies the uniform resource locator of the selected 25 web/emulation server 74. Client system 72 then initiates the above described terminal session through the selected web/emulation server 74 and the selected web/emulation server 74 connects to the legacy host system as described above.

The present invention provides web browser 30 connectivity with relatively low initial and recurring cost. The need for individual emulation software products based upon each particular client system is removed. This eliminates many technical support, help desk and software distribution problems, including 35 version level control and configuration management.

issues. Extensive user training is no longer necessary because web browsers generally offer intuitive common user interfaces and are known by many users.

5 Implementation time is improved by taking advantage of an existing widely-installed web browser base.

10 Specifically, the platform independence provided by the JAVA architecture allows the web browser terminal emulator of the present invention to avoid problems with operation differences between computer environments. In addition, numerous users can be supported concurrently by each web/emulation server. For example, the OC://WEBCONNECT™ product from OPENCONNECT SYSTEMS can support a thousand users per instance.

15 The present invention provides connectivity from any client system, such as a personal computer or computer workstation, to a legacy host system, such as a mainframe or mid-range system, without costly redesign or rebuilding of legacy applications. The benefits of a distributed client/server type data exchange can be 20 realized without requiring systems redesign. This approach means that the many advantages of Internet-type access and functionality can be blended into an organization's network architecture simply and efficiently, thus protecting existing information 25 technology infrastructures and investments.

30 Although the present invention has been described in detail, it should be understood that various changes, substitutions and alterations can be made hereto without departing from the spirit and scope of the invention as defined by the appended claims.

## APPENDIX A

The following provides one implementation of a communication protocol for web/emulation data flow between a client thread and an applet process. (For all values with a length, length = 0 indicates the field is not present. All fields are byte values.)

Client (applet process) to Server (client thread)  
Connect Session

```

    / H /
Process Emulation Keystroke
    / K / keyvaluehigh I keyvaluelow
        keyvaluehigh I keyvaluelow: Emulation
5      key value to process

Server (client thread) to Client (applet process)
Erase Display
    / E /
10     Set Display Size
        / S / rows / columns
            rows: Number of rows for display
            columns: Number of columns for display
Set Cursor Position
15     / C / bufposhigh, bufposlow
        bufposhigh, bufposlow: Position for cursor
Display Text
    / D / bufposhigh I bufposlow I lengthhigh I
        lengthlow I text...
20     bufposhigh, bufposlow: Position for text
        (Ignored when in NVT mode) lengthhigh,
        lengthlow: Len-th of text (16 bits)
        text: ASCII text for display
OIA     Text
25     / O / column / length / oia text ...
Field   List
    / F / fieldcounthigh, fieldcountlow / bufposhigh /
        bufposlow / fieldattr / xattr / lengthhigh /
30     lengthlow fieldcounthigh, fieldcountlow: Number of
        fields (0 = unformatted screen) bufposhigh,
        bufposlow: Position for start of field fieldattr:
        Field attribute byte
            3270     definition
            bits     use
35     0     Modified Data Tag (I @ field
            modified)
            0     Reserved (0)
            2 - 3   00 = Display/non-detectable, 01 =
                    Display/detectable, 10=Intensified
40     Display/detectable, 11
            =Nondisplay/non-detectable
            4     0= Alphanumeric, 1 = Numeric
            5     0 = Unprotected, 1 = Protected
xattr: Field extended attribute byte 3270 Definition
45     3270 Definition
            bits     se
            7     field mark
            6     unused
            5     transparent/opaque
50     4-3     highlighting (00=default, 01
            =blinking, 10=reverse, 11=underline)

```

2-0            color(00 1=blue, 010= red, 011=pink,  
               100=green, 101=turquoise,110=yellow,  
               111=white)  
 5            lengthhigh, lengthlow: length of field (16  
               bits, may wrap off initial row)  
               bufposhigh, btifposlow, fieldattr, lengthhigh,  
               lengthlow are repeated fieldcounthigh,  
               fieldcountlow times.  
 10            Character Override Attribute List  
               /A / attrcounthigh / attrcountlow / bufposhigh /  
               bufposlow / lengthhigh / lengthlow / attrbytel  
               attrcounthigh, attrcountlow: Count of attributes  
               bufposhigh, biifposlow: Position of attribute  
 15            lengthhigh, lengthlow: length of field (16  
               bits, may wrap off initial row)  
               attrbytel: Attribute byte 1  
               3270        Definition  
               bits        use  
 20            0 - 2      color bits (1 = Blue, 2 = Red, 3  
               = Pink, 4 = Green, 5 =  
               Turquoise, 6 = Yellow, 7 =White)  
               3 - 4      Extended highlighting (mutually  
               exclusive) (01= Blinking, 10 =  
 25            7           Reverse, 11 = Underline)  
               Field mark (1= Start of field  
               position)  
               bufposhigh, bufposlow, lengthhigh, lengthlow,  
               attrbytel are repeated attrcounthigh,  
               attrcountlow times.  
 30            Query Field Update  
               / Q / reasonparm  
               reasonparm: Reason value returned in Field  
               Update message from client  
 35            Set NVT Mode  
               / N / nvtmode  
               nvtmode: 00 = Emulation mode, 0 1 = NVT mode  
               Keyboard Lock State  
               / K / mode  
 40            mode: 00 = KB Free, 01 = KB Locked  
               Sound Alarm  
               / B / length / filenametext ...  
               length - Length of filename  
               filenametext: Name of audio file for alarm  
 45            Error Message  
               / M / length / messagetext...  
               length, messagetext: Length and content of  
               error message  
               Protocol Version  
               / V / verhigh / verlow  
               verhigh, verlow: Protocol version number  
 50            Help Desk Reply

```
    / H /
    length / versionstr: Server version
    sessionIDhigh / sessionIDlow: server session ID
    for this client connection
    5      emulationtype: 01 = 3270, 02 = 5250
    (if emulation type is 3270)
        displaytype: 00 = 3278, 01 = 3279, 02 =
        3179, 03 = 3472
        status: 00 = Unowned, 01 = SSCP, 02 =LULU
        10     defaultPartition.- default model size 2 -
        5
        alternatepartition: alternate model size 2
        - 5
        currentpartition: current model size 2 - 5
        15     (if emulation type is 5250)
        displaytype: 00 = 3477, 01 = 3179, 02 =
        5151, 03 = 3196
        screensize: screen size, 2 or 5
        ocserver: 01= connected to OC server, 00 =
        other type of server
        20     ptsoVERRIDE: 01 = passthru screen
        override, 00 = no override
        monochrome: 00= color, 01 = monochrome
        protocoltype: 0 1 = RUI, 02 =TN
        25     (if protocol type is RUI)
        length /requestedLUname: configured LU name
        length/grantedLUname: LU name returned by
        server
        length/ruiversion: Version of RUI support
        30     in use
        sessIDhigh I sessIDlow: RUI session ID
        (if protocol type is T-N)
        length, termTypeString: terminal type
        string negoiated with TN server is
        35     TN3270EI: 00 = not 3270E, 01 = using 3270E
        length, devicename: device name in use
        length, puLuName: PU/LU name for session
        (OCS gateways only)
        transporttype. 00= None (valid if protocol is
        40     RUI), 01 = Network (if transport type is
        Network)
        length, configuredHostName: host name in
        session configuration
        length, configuredport: port in session
        configuration
        45     length, connectedHostName: host name (ip
        address) in actual use
        length, connectedport: port in actual use
        Update Complete
        50     / W /
```

WHAT IS CLAIMED IS:

1. A web/emulator server for providing a persistent connection between a client system and a legacy host system, comprising:
  - 5 a client thread operable to communicate with a legacy host system across a first persistent TCP/IP socket connection; and
  - 10 applet code operable to create an applet process executing under a web browser on a client system, the applet process operable to communicate with the client thread across a second persistent TCP/IP socket connection and to provide a terminal session to a user of the client system;
  - 15 the web/server emulator operable to download the applet code to a client system in response to receiving a uniform resource locator associated with the legacy host system.
- 20 2. The web/emulator server of Claim 1, wherein the client thread and the applet process are operable to communicate using a web/emulator data flow.
- 25 3. The web/emulator server of Claim 2, wherein the client thread is further operable to interface between a legacy data flow used by the legacy system and the web/emulator data flow used by the applet process.
- 30 4. The web/emulator server of Claim 3, wherein the applet code comprises executable code for a JAVA applet to be executed under a JAVA-capable web browser.
- 35 5. The web/emulator server of Claim 4, wherein the web/emulator server is implemented by an OC://WEBCONNECT server.

6. The web/emulator server of Claim 1, wherein the client thread is operable to communicate using a TN3270 data flow and the applet process is operable to provide a 3270 type terminal session.

5

7. The web/emulator server of Claim 1, wherein the client thread is operable to communicate using a TN5250 data flow and the applet process is operable to provide a 5250 type terminal session.

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8. The web/emulator server of Claim 1, wherein the client thread is operable to communicate using an NVT data flow and the applet process is operable to provide an NVT type terminal session.

15

9. The web/emulator server of Claim 1, wherein the client thread is operable to communicate using a VT220 data flow and the applet process is operable to provide a VT220 type terminal session.

10. A web browser terminal emulator for connecting a client system to a legacy host system, comprising:

5 a client thread executing under a web/emulator server on a server system, the client thread operable to communicate with a legacy host system across a first persistent TCP/IP socket connection; and

10 an applet process executing under a web browser on a client system, the applet process operable to communicate with the client thread across a second persistent TCP/IP socket connection, and the applet process further operable to provide a terminal session to a user of the client system;

15 such that the terminal session is supported by a persistent connection allowing real-time bidirectional communication with the legacy host system.

20

11. The web browser terminal emulator of Claim 10, wherein the client thread and the applet process are operable to communicate using a web/emulator data flow.

25

12. The web browser terminal emulator of Claim 11, wherein the client thread is further operable to interface between a legacy data flow used by the legacy system and the web/emulator data flow used by the applet process.

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13. The web browser terminal emulator of Claim 12, wherein the applet process comprises a JAVA applet executing under a NETSCAPE NAVIGATOR web browser.

14. The web browser terminal emulator of Claim 13, wherein the web/emulator server comprises an OC://WEBCONNECT server.

15. A computer network environment allowing connection of a client system to a legacy host system using a web/emulator server, the computer network environment comprising:

5 a legacy host system having TCP/IP connectivity, the legacy host system operable to support a terminal session for access to the legacy host system;

10 a server system executing a client thread under a web/emulator server, the client thread operable to communicate with the legacy host system across a first persistent TCP/IP socket connection; and

15 a client system executing an applet process under a web browser, the applet process operable to communicate with the client thread across a second persistent TCP/IP socket connection and operable to provide a terminal session to a user of the client system;

20 such that the terminal session is supported by a persistent connection allowing real-time bidirectional communication with the legacy host system.

20

16. The computer network environment of Claim 15, wherein the client thread and the applet process are operable to communicate using a web/emulator data flow.

25

17. The computer network environment of Claim 16, wherein the client thread is further operable to interface between a legacy data flow used by the legacy system and the web/emulator data flow used by the applet process.

30

18. The computer network environment of Claim 15, wherein the legacy host system comprises a mainframe computer system.

19. The computer network environment of Claim 15, wherein the legacy host system comprises a mid-range computer system.

5 20. The computer network environment of Claim 15, wherein the legacy host system comprises a computer workstation executing a UNIX environment.

10 21. The computer network environment of Claim 17, wherein the applet process comprises a JAVA applet executing under a NETSCAPE NAVIGATOR web browser.

15 22. The computer network environment of Claim 21, wherein the web/emulator server comprises an OC://WEBCONNECT server.

20 23. The computer network environment of Claim 15, wherein the client thread is operable to communicate using a TN3270 data flow and the applet process is operable to provide a 3270 type terminal session.

25 24. The computer network environment of Claim 15, wherein the client thread is operable to communicate using a TN5250 data flow and the applet process is operable to provide a 5250 type terminal session.

30 25. The computer network environment of Claim 15, wherein the client thread is operable to communicate using an NVT data flow and the applet process is operable to provide an NVT type terminal session.

35 26. The computer network environment of Claim 15, wherein the client thread is operable to communicate using a VT220 data flow and the applet process is operable to provide a VT220 type terminal session.

27. A method for connecting a client system to a legacy host system using a web/emulator server, comprising:

5        selecting a uniform resource locator associated with a legacy host system from a web browser executing on a client system;

      receiving the uniform resource locator by a web/emulator server executing on a server system;

10      downloading executable code for an applet process to the client system;

      executing the applet process under the web browser on the client system;

15      connecting the applet process to a client thread executing under the web/emulator server via a first persistent TCP/IP socket connection;

      connecting the client thread to a legacy host system associated with the uniform resource locator via a second persistent TCP/IP socket connection;

20      communicating between the client thread and the legacy host system across the first persistent TCP/IP socket connection;

      communicating between the client thread and the applet process across the second persistent TCP/IP socket connection; and

25      providing a terminal session to a user of the client system by the applet process, the terminal session allowing real-time bidirectional communication with the legacy host system across a persistent connection to the legacy host system.

30

28. The method of Claim 27, wherein communicating between the client thread and the legacy host system is accomplished using a legacy data flow.

29. The method of Claim 28, wherein communicating between the client thread and the applet process is accomplished using a web/emulator data flow.

5 30. The method of Claim 29, wherein executing the applet process comprises executing a JAVA applet under a NETSCAPE NAVIGATOR web browser.

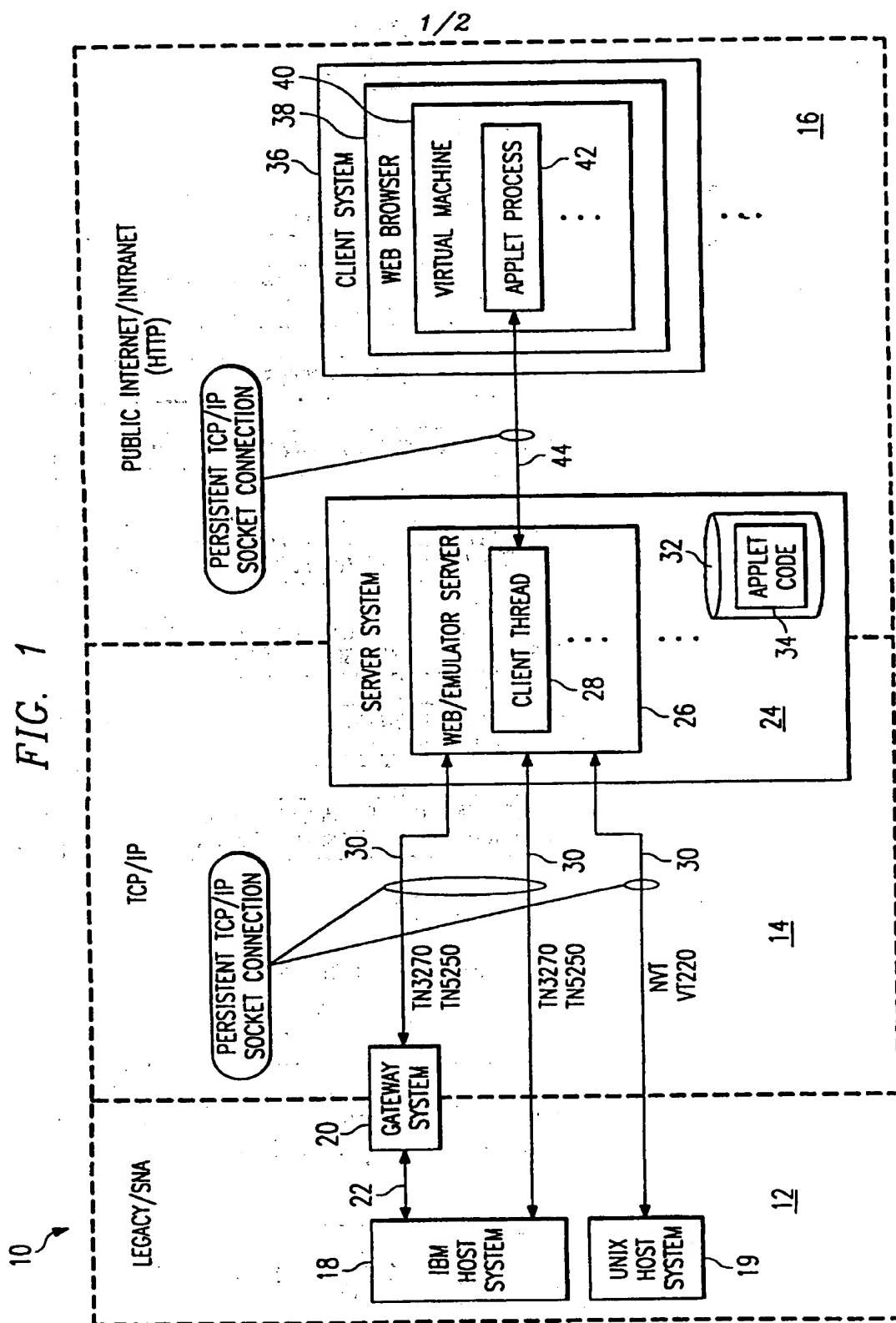
10 31. The method of Claim 27, wherein providing a terminal session comprises providing a 3270 type terminal session.

15 32. The method of Claim 27, wherein providing a terminal session comprises providing a 5250 type terminal session.

20 33. The method of Claim 27, wherein providing a terminal session comprises providing an NVT type terminal session.

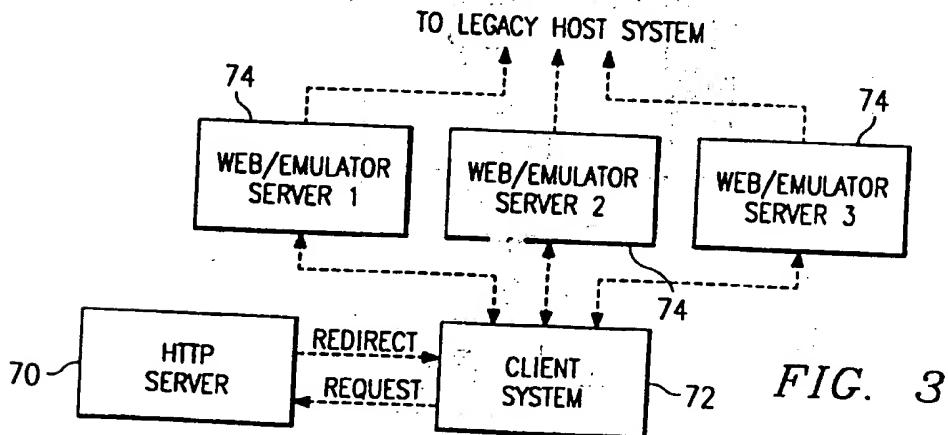
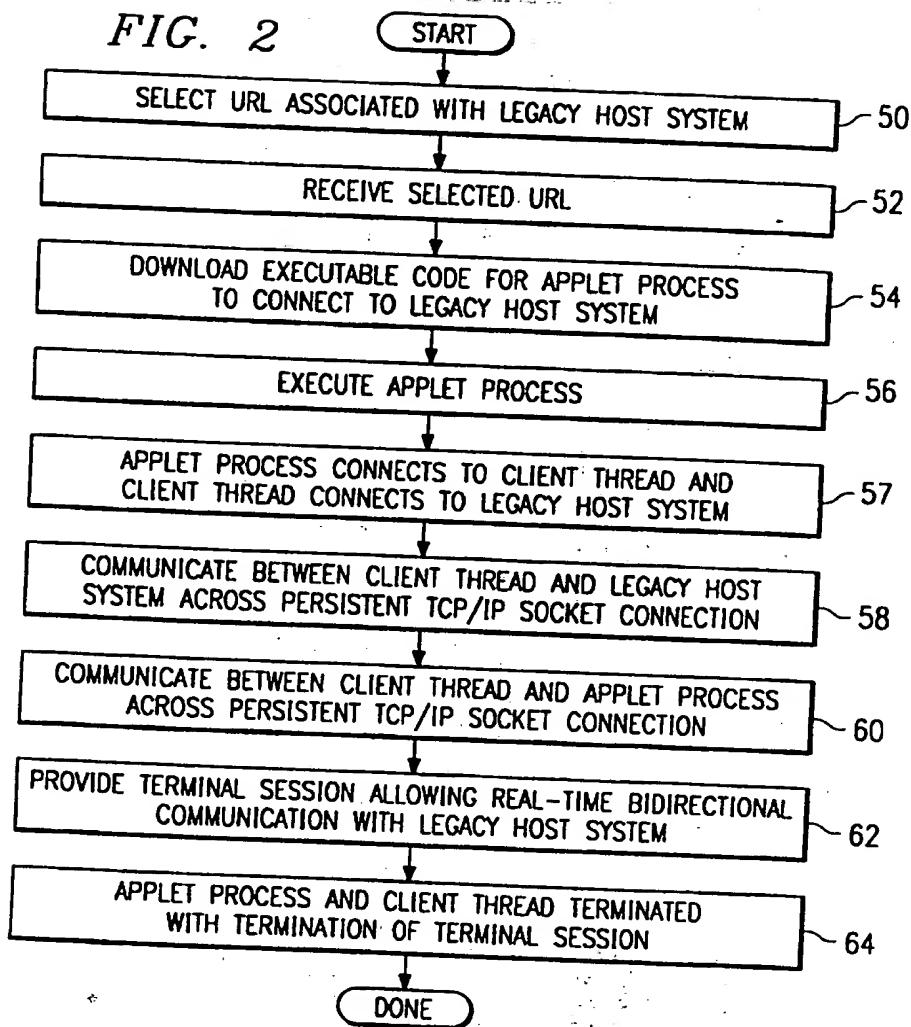
34. The method of Claim 27, wherein providing a terminal session comprises providing a VT220 type terminal session.

FIG. 1



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FIG. 2



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US97/05196

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G06F 9/455, 13/00

US CL :395/500, 680, 285, 200.01; 370/466, 469; 364/232.3, 927.81

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : Please See Extra Sheet.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS; IEEE

Search terms: network, host, client (thread), emulator, applet, persistent, legacy

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,485,369 A (NICHOLLS ET AL) 16 JANUARY 1996, COLUMNS 1-27	1-34
A	US 5,497,463 A (STEIN ET AL) 05 MARCH 1996, COLUMNS 1-152	1-34
A,P	US 5,568,612 A (BARRETT ET AL) 22 OCTOBER 1996, COLUMNS 1-56	1-34
A,P	US 5,600,833 A (SENN ET AL) 04 FEBRUARY 1997, COLUMNS 1-23	1-34
A,E	US 5,617,540 A (CIVANLAR ET AL) 01 APRIL 1997, COLUMNS 1-10	1-34
A,E	US 5,619,650 A (BACH ET AL) 08 APRIL 1997, COLUMNS 1-11	1-34

 Further documents are listed in the continuation of Box C. See patent family annex.

• Special categories of cited documents:	
*A* document defining the general state of the art which is not considered to be of particular relevance	"T" later documents published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*E* earlier document published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reasons (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*O* document referring to an oral disclosure, use, exhibition or other means	"Z" document member of the same patent family
*P* document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search  
01 JULY 1997

Date of mailing of the international search report

13 AUG 1997

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## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US97/05196

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	DOMEL, P. Mobile Telescript Agents and the Web. COMPCON '96 IEEE Computer Society International. 1996, pages 52-57.	1-34
Y	DEAN et al. Java Security: From HotJava to Netscape and Beyond. Security and Privacy 1996 IEEE Symposium. February 1996, pages 190-200.	1-34
Y	VUONG et al. Mobile Intelligent Agent Systems: WAVE vs. JAVA. Emerging Technologies and Applications in Communication 1996 IEEE Conference. March 1996, pages 196-199.	1-34
Y,P	HAMILTON, M. Java and the Shift to Net-Centric Computing. IEEE Computer Magazine. August 1996, pages 31-39.	1-34
Y,P	YOURDON, E. Java, the Web, and Software Development. IEEE Computer Magazine. August 1996, pages 25-30.	1-34
A	NEWELL et al. Interoperable Object Models for Large Scale Distributed Systems. IEE Colloq. No. 184: Client/Server Computing Seminar Proceedings. 1995, pages 14/1-14/6.	1-34

Form PCT/ISA/210 (continuation of second sheet)(July 1992)\*

INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US97/05196

**B. FIELDS SEARCHED**

Minimum documentation searched

Classification System: U.S.

395/500, 680, 601, 285, 200.01, 200.02, 200.3, 200.06, 200.11, 200.14, 200.21; 370/466, 469, 455; 364/280, 280.6, 283.1, 284.2, 232.3, 927.81

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